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Oil + Gas

OIL AND GAS

IN

WESTERN CANADA

Department of the Interior
Canada

Hon. Sir James A. Lougheed, K.C.M.G.,
Minister

W. W. Cory, C.M.G.
Deputy Minister

Natural Resources Intelligence Branch
F. C. C. Lynch, Superintendent.

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Compiled under the direction of the Superintendent
Natural Resources Intelligence Branch

This report embodies information supplied by Mr. D. B. Dowling of the Geological Survey of Canada, Mr. S. E. Slipper, Petroleum Engineer, of the Mining Lands and Yukon Branch, the Controller of the Mining Lands and Yukon Branch, and by the Board of Public Utility Commissioners for the Province of Alberta, in collaboration with the Natural Resources Intelligence Branch of the Department of the Interior. The assistance rendered by these authorities is gratefully acknowledged.

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CONTENTS

	PAGE
I. Topography, Climate, Transportation and General Development of Western Canada's Oil and Gas Fields.	5
Natural Resources Intelligence Branch, Department of the Interior.	
II. The Rocks of the Plains.	10
D. B. Dowling, Geological Survey of Canada.	
III. The Development of the Petroleum and Natural Gas Resources of Western Canada.	16
S. E. Slipper, Petroleum Engineer, Mining Lands and Yukon Branch, Department of the Interior.	
IV. Synopsis of the Petroleum and Natural Gas Regulations governing the disposal of such rights on Dominion Lands	24
The Controller, Mining Lands and Yukon Branch, Department of the Interior.	
V. Synopsis of Provincial Legislation and Regulations governing the sale of Shares, Stocks, Bonds, etc.	25
Board of Public Utility Commissioners for the Province of Alberta.	

I

Topography, Climate, Transportation and General Development in Western Canada's Oil and Gas Fields.

Western Canada has assumed during recent years a position of primary importance in the eyes of the great oil producers of America and Europe as a possible field for future production on a large scale. Resources associated in this connection include crude petroleum, natural gas, coal and bituminous sands, all of which are known to exist, in greater or lesser quantities, throughout this territory. Recent discoveries indicate that the greatest oil fields of the world may be found in Canada's far northlands.

Geologists and practical oil men have agreed that the indications of crude oil in commercial quantities are of sufficient importance to warrant an extensive program of systematic prospecting and developing. Such work is already well under way; preliminary results are believed to be very encouraging and increased activity in this connection is assured. It is not improbable that Western Canada will shortly take a rank with the greatest oil producing countries of the world.

Natural gas has been discovered at innumerable points throughout this immense area. Some of the more productive fields have been commercially exploited while others are awaiting a market that the development of the surrounding country will create. Examples of these opposite conditions are to be seen, for instance, at Medicine Hat, in southern Alberta, and at Pelican rapids, on Athabaska river, in the northern part of the same province. At the former place the utilization of great gas fields has resulted in the development of an industrial centre of great commercial importance to the development of the West. The reverse condition is seen at the latter location where a gas well that had been drilled many years ago by a Government geological exploratory party and from which enormous quantities of gas continued for years to escape, has recently been capped to await the day when the advance of settlement will give it commercial value.

Coal is found in widely distributed areas and almost inexhaustible quantities. Southwestern Manitoba and southern Saskatchewan contain great deposits of lignite. Alberta has most extensive fields of lignite, high-grade bituminous and semi-anthracite. British Columbia has various fields of this valuable and necessary fuel, the most renowned being those located on Vancouver island. Even in the far Mackenzie district there still burns a coal seam, the fires of which were observed by Alexander Mackenzie on his voyage of discovery in 1789 down the great river that bears his name.

It has been estimated that the province of Alberta alone contains about 15 per cent of the world's supply of coal. The Geological Survey of Canada have made extensive examinations of the coal areas of Western Canada and have published several reports in this connection. Mining has assumed considerable proportions though in the case of the Prairie Provinces it is restricted to a local trade as yet.

An extensive deposit of bituminous sand, commonly referred to as tar sand, outcrops at various places in Alberta in the vicinity of McMurray, on the Athabaska river. S. C. Ells, of the Canadian Department of Mines, who has spent several years on the investigation of this resource, reports the examination of some 250 exposures within a radius of 60 miles of McMurray and which represent one continuous deposit. His reports claim these deposits to represent the largest known occurrence of solid asphaltic material. As yet it is totally undeveloped.

Experiments have been conducted in which the bituminous sands have been retorted with a recovery of crude petroleum. The crude oil thus obtained was then fractionated and the various fractions refined. Possibilities of such distillation on a commercial scale, however, have yet to be determined. The development of this vast resource will be followed with much interest.

These natural resources, in both the province of Alberta and the District of Mackenzie, are controlled and administered by the Federal Government of Canada from the head offices at Ottawa through a number of local agencies with offices in Lethbridge, Calgary, Edmonton, Peace River and Grande Prairie. In the Mackenzie district, there are sub-agencies at Fort Smith and Simpson.

The principal areas of Western Canada receiving particular attention in respect to petroleum and natural gas might be restricted to the province of Alberta and that portion of the district of Mackenzie lying north of this province. The scope of this report has been confined to these areas, though that fact does not by any means signify that such resources are so restricted. Manitoba and Saskatchewan not only possess indications of the presence of underlying areas of crude petroleum and natural gas but are definitely known to contain extensive deposits of oil shales which may eventually be treated with commercial success. In British Columbia also an era of drilling is being produced in selected localities, but Alberta and the Mackenzie district constitute the present favourite fields.

This field represents an area of about 455,000 square miles, Alberta has a total of 255,285 square miles, while that part of the district of Mackenzie lying between the northern boundary of Alberta and the Arctic coast and extending to a depth of 100 miles on each side of the main waterway contains approximately 200,000 square miles. In latitude the field extends from 49° north (which is the Canadian-American boundary here, or more locally, the Alberta-Montana boundary) to 69° north, the approximate latitude of the mouth of the Mackenzie river. In longitude the south-eastern corner of the field commences at 110° west, while the northwestern extremity reaches 136° west.

Practically this whole area lies within the Great Plains region of Western Canada. Westerly it merges into the Cordilleean while from the east the Laurentian plateau intrudes at the extreme northern part of Alberta and irregularly in the Mackenzie district. The Great Plains region rises in three steppes, from east to west, Alberta occupying, roughly speaking, the third or highest steppe. From this it ascends through the foothills regions to the Rocky mountains, the eastern extremity of the Cordilleean. To the north the land falls in elevation till the great delta of the Mackenzie river is reached, the elevation of which is slightly above sea level.

As would be inferred by reference to the physiographic division to which this area belongs the greater part of its surface is comparatively level. The southern part of Alberta is prairie land containing many large level stretches as well as much rolling country broken by deep ravines and coulees. The foothills and mountains give the southwestern part of the province a predominating elevation.

The central part of the province is slightly less rolling and open prairie gives way to a considerable growth of brush and park land and light woods. Fairly heavy timber is found in some of its valleys. The more northerly part of the province is lower and flatter and has less prairie.

The Mackenzie district slopes gently to the Arctic coast, the main valley of the Mackenzie being flanked on the west by the Rocky mountains and on the east by the rugged plateaus of the Laurentian division. About midway the Franklin mountains, an offshoot of the Rockies, cross the valley and continue for some distance along the easterly bank.

The Mackenzie drainage basin embraces the northern part of the oil and gas fields under discussion. Its two main feeders, the Peace and the Athabaska, which receive practically all the water from the northern half of Alberta, unite at lake Athabaska and thence drain through a common channel known as the Slave river

to that great inland reservoir, Great Slave lake. From this lake the Mackenzie river flows westerly and northerly to the Arctic coast. Its principal tributaries in this section are the Liard, entering from the west, the Great Bear, which drains Great Bear lake from the east and the Peel which, though strictly not a tributary, shares a common estuary. The delta of the Mackenzie and Peel is some 100 miles in length and a network of channels spreads out over a great width throughout this length.

The main settled part of Alberta falls within the Saskatchewan drainage system, of which the main Saskatchewan river and its southern branch form the principal arteries of flow. The Red Deer and the Bow are tributaries of the latter. This system has an easterly flow, eventually reaching Hudson bay.

A small area in the southern part of Alberta drains to the Mississippi, the principal channel being the Milk river. The Saskatchewan river can be navigated by small light draught steamers but since the advent of railroads they are but little utilized in this connection. The northern rivers, however, still represent the chief routes of travel.

The general elevation of the third Prairie steppe in Alberta runs from 2,000 to 4,000 feet above sea level. A peculiarity throughout this area is the variation in elevation between the land and the valleys of the rivers. Some valleys assume the proportions of gorges, others, though wide, lie at depths of approaching 1,000 feet below the level of the surrounding land, giving to the adjacent districts the features of plateaus. This peculiarity gives way north of latitude 60, the boundary between Alberta and Mackenzie. Here the land rapidly falls to a closer level with the waters of Great Slave lake and the Mackenzie river.

The following altitudes are representative of this field: Lethbridge 2,983, Macleod 3,116, Medicine Hat 2,181, Calgary 3,440, Bow Island 2,621, Crowsnest Pass (Canadian Pacific Railway) 4,459, Kicking Horse Pass (Canadian Pacific Railway) 5,332, Red Deer 2,818, Edmonton 2,185, Viking 2,267, Yellowhead Pass (Canadian National Railway) 3,716, Peace River 1,092, McMurray 804, Great Slave lake 520.

The climate of this great area varies chiefly according to latitude and except for the extremes of Arctic winter conditions in the far northerly portions may be said to be most agreeable. Alberta is noted for its bright, clear skies, sunny days and exhilarating atmosphere. During the summer season the rainfall is light, the days warm and bright and the nights cool. The winters are marked by a light snowfall and a clear, dry, crisp cold that contrasts most agreeably with the penetrating damp of other climates. Even the rigours of the Mackenzie district are not so severe as usually represented, while its summers are most delightful.

Southern Alberta is a semi-arid area and irrigation projects are to be seen on large scales. The winters are short and the snowfall is very light. Currents of warm air from the Pacific coast known as "Chinook winds" find their way at frequent intervals through passes in the mountains and rapidly melt and evaporate any accumulating snow.

In central and northern Alberta precipitation is somewhat heavier though it averages only between 15 and 20 inches per year. The "Chinook winds" are not felt so frequently and the winters are slightly longer. At Edmonton the freeze-up occurs towards the latter part of October as a rule, and seeding operations commence about the 1st of April.

The effects of the "Chinook winds" are sometimes felt as far north as the Liard river at Simpson, its junction with the Mackenzie. North of this point climatic conditions assume the Arctic peculiarities. At Norman the river clears of ice about the 1st of June and freezes over again in October. The northern winters are marked by a clear, still cold, not unduly severe except for short spells. The summers are warm and delightful with a three-months continual daylight. The midnight sun is visible at McPherson from about the 1st of June until the 12th of July. On the whole the climate of the Western Canada oil fields may be said to be remarkably healthful, enjoyable and free from any serious drawbacks other than causing a limitation of work during the more severe part of winter.

Farming and ranching are the principal industries of Alberta. The southern part of the province was first exploited by cattlemen and for many years ranching alone held sway. Later mixed farming, grain growing and even intensified farming succeeded so that now the province not only boasts of its live stock but also of its wheat, barley, oats and vegetables of all descriptions. The land is fast being brought under cultivation, the southern dry areas irrigated and the northerly wooded areas cleared. The Peace River district represents an example of recent rapid development.

Second only to this agricultural activity is the mining industry, coal being the chief product. The local markets are being extended and nothing but the transportation problem stands in the way of Alberta's coal fields supplying fuel for the whole of interior Canada.

Manufacturing is following the wake of settlement. In this connection the utilization of natural gas fields is most important, the industrial city of Medicine Hat being a noteworthy example. The fur trade of the Mackenzie district still represents its principal commercial activity.

In Alberta are found six cities and a large number of thriving towns. The cities are Calgary, Edmonton, Medicine Hat, Lethbridge, Red Deer and Wetaskiwin.

Calgary is the largest city in Alberta and is situated at the junction of the Bow and Elbow rivers, at the entrance to the foothills. It is an important divisional point on the main line of the Canadian Pacific railway, and the radial centre for many branch lines. This city is most modern in its business, professional and social life.

Edmonton is the capital of the province and is situated on the Saskatchewan river on the main line of the Canadian National railways (Canadian Northern and Grand Trunk Pacific). It has also rail connections with Calgary to the south and the Athabaska and Peace River districts to the north. It occupies a most strategic position in respect to central Alberta and the great northlands and like Calgary is quite modern.

Medicine Hat by reason of its underlying natural gas resource has come to be an industrial and manufacturing city of great importance to Western Canada. Lethbridge is located in the southern part of the province and was formerly the centre of the ranching industry of Alberta. Red Deer and Wetaskiwin are growing cities located on the Canadian Pacific Calgary-Edmonton line and are important centres of the great mixed farming areas of central Alberta.

The population of Alberta is placed by provincial officers at approximately 625,000. The city of Calgary is credited with a population of 70,000 and Edmonton with 60,000. The rural population is about 60 per cent of the total.

The far north districts are as yet scantily peopled. Whites are restricted to a handful of traders, missionaries and police. Indian tribes are scattered as far north as the Mackenzie delta, beyond which are found the Eskimos.

Transportation is a matter of prime importance in these fields. Southern and central Alberta are well supplied with railroads but the northern part of Alberta and the Mackenzie valley have none at all. The main line of the Canadian Pacific railway passes from east to west through the southern part of Alberta. Medicine Hat, Calgary and Banff are located on it. To the south this company has a network of branch lines covering the field thoroughly. The company also has a line connecting Calgary with Edmonton and additional lines from the east joining it. Edmonton is on the main line of both Canadian National railways, that is the lines formerly known as Canadian Northern and Grand Trunk Pacific. Both these lines have also branches running south to Calgary as well as local feeders. All these roads are in good condition and operate standard passenger and freight services at frequent intervals.

Peace River is reached from Edmonton by the Edmonton, Dunvegan and British Columbia railway which has recently been taken over by the Canadian Pacific Railway Company. McMurray, on the Athabaska river, is connected with Edmonton by the Alberta Great Waterways railway which has recently been taken over by the Alberta Provincial Government. These northern railways are pioneer roads and have

never been put in good repair but it is hoped that with the change of control they will shortly be brought up to a satisfactory standard.

The northern part of Alberta and the Mackenzie district are served by river steamboats plying on the Peace, Athabaska, Slave and Mackenzie rivers during the summer season. Interruptions to navigation occur on Peace river at Vermilion chutes about 50 miles below Fort Vermilion and on Slave river at Fort Smith on the Alberta-Mackenzie boundary. Freight going by way of the Peace river route thus requires two portages and by the Athabaska route one portage to reach the Mackenzie. Three transportation companies operate boats on these routes and manage to handle the limited amount of northern freight yet offering. With the development of the north more satisfactory means of transportation will have to be provided.

Country roads throughout the settled part of Alberta are built by the provincial government to keep pace with the requirements of the various districts. Owing to a general scarcity of gravel and stone in the more northerly areas these roads are built of dirt only. They are usually well graded, however, ditched and provided, where necessary, with bridges. In the wet seasons they are muddy and heavy but at other times make excellent highways.

A better idea of distances involved in the exploitation of these fields might be had by referring to the mileage of common routes of travel in connection therewith. Calgary lies 832 miles west of Winnipeg and 642 miles east of Vancouver by the main line of the Canadian Pacific railway. Lethbridge is 140 miles south and Edmonton 194 miles north of Calgary by branches of the same railway system. From Winnipeg to Edmonton by the Canadian National Grand Trunk Pacific division, the distance is 801 miles and from the latter city to Prince Rupert 957 miles. The Canadian Northern division connects Edmonton with Vancouver by 771 miles of direct track. Peace River is reached by the Edmonton, Dunvegan and British Columbia railway in 312 miles from Edmonton, and McMurray, on Athabaska river, connects with the same city by the Alberta Great Waterways railway with a mileage of 290.

The Peace River-Fort Smith route involves 300 miles by steamboat to Vermilion chutes, a 4-mile portage by wagon road and another steamboat run of 275 miles to Fitzgerald after which a second portage of 16 miles wagon road is necessary to reach Fort Smith. By way of Athabaska river there is a steamboat run of 285 miles from McMurray to Fitzgerald. Boats on these runs maintain a weekly schedule from the middle of May to early in October.

Below Fort Smith is the great Mackenzie run, there being uninterrupted navigation from this point to the Arctic ocean. Steamers have as yet been running only to the delta and McPherson on Peel river and making but one trip per season at that to these points. They are met at McPherson by gas boats and schooners from the coast and Herschell island. Other trips are made as far north as Norman, Simpson, and Great Slave lake as required. Approximate distances on this route are as follows, from Fort Smith to: Resolution (Great Slave lake) 195 miles; Hay River (Great Slave Lake) 265 miles; Providence 360 miles; Simpson (mouth of Liard river) 525 miles; Wrigley, 660 miles; Norman (mouth of Great Bear River) 845 miles; Good Hope, 1,015 miles; Arctic Red River, 1,235 miles; McPherson (Peel river), 1,300 miles.

Experienced men for preliminary exploratory work can be secured without difficulty in any of the cities or towns of this field. The recent surveying and pioneering of these frontiers has trained a large corps of hardy men to the peculiar needs of such work. Local guides, canoe and river men, freighters, axemen and trail makers, both white and native, can be relied upon to carry out primary work. Experienced drillers, however, are not found in these parts.

With the exception of drilling machinery, tools and casing, peculiar to their own work, oil and gas men will find that they can obtain to their advantage all necessary supplies for their camps at such centres as Calgary and Edmonton. The larger supply houses of these cities have made a business for decades of outfitting all classes

of pioneers with complete stocks. Fur trading posts, surveying parties, lumber camps, prospectors, sportsmen and all who go into the wilds for protracted periods rely upon these houses. Experience has taught them the needs of such camps and it is safe to say that in the larger or even in many of the smaller cities and towns a party will secure the necessities in food, clothing and ordinary camp equipment, with greater satisfaction than at any outside points.

It should be borne in mind by those interested in petroleum and natural gas prospecting that should these resources be found in large quantities there is as yet no local market of corresponding extent. Alberta is comparatively a new province with a population of slightly over half a million. The Mackenzie offers practically no market at all. Transportation of oil to distant markets represents a great problem. Millions of dollars would have to be spent in providing some economical line of transport before these oils of the Mackenzie, for instance, could be handled to commercial advantage. The investor will do well to bear these phases of the situation in mind.

II.

The Rocks of the Plains.*

The rocks that underlie the plains are generally of a soft nature and easily eroded, so that the topography shows but very few indications of the influence which the underlying rocks often have on the general outline. Even the courses of the rivers which cross the plains appear to have been deflected from the direct course more by glacial action than by the strike of the rocks. The structure of the underlying beds is thus in great part to be interpreted from the exposures of the rocks on the banks of the stream valleys, and from the records of deep borings. The order in which the beds were laid down, the condition under which they were deposited, and the shape of the basin in which they are now found is the special study of the geologist. From his maps and diagrams the extent of coal fields and the probable position of oil or gas fields are also inferred. As the beds beneath the plains are largely the deposits of a muddy sea the various sheets are of fairly uniform thickness, the variations are found to be slight and to conform to a general thickening to the west toward the source of the material which was the detritus brought into the sea. This variation is accentuated by the addition of sand sheets which indicate periodical shallowing or retreats of this interior arm of the sea. The muds deposited and the sand beds of the shallow shore are now hardened into shales and sandstones, and both contain remains of the life of the times; in the shales, marine shells are to be found denoting subsidence beneath the sea, and in the sandstones coal seams and shells, denoting estuarine or land conditions. The tracing out of these beds has shown plainly that they are now occupying a very large basin, so that a bed which outcrops along the eastern side of the plains is covered by other beds in the central part but may be looked for again to the west in the foothills. In the bottom of this basin, in Canada, there seem to be two very deep depressions, the eastern one centering about Estevan, and the western one, a long narrow one, in front of the foothills. All the beds dip into these hollows, and as the present surface is formed by the mechanical plaining action of streams the beds which are the latest deposits are to be found either over these structural hollows or capping the highest hills. Thus the depression or syncline in front of the foothills is occupied by Tertiary beds of fresh-water origin, and the depression at Estevan by similar beds containing coal seams. Below the western Tertiary a coal formation, mainly of brackish-water origin and called the Edmonton formation, is exposed in the banks of the Saskatchewan river at Edmonton and of the Red Deer

* By D. B. Dowling, Geological Survey of Canada.

river near Drumheller. It practically surrounds the Tertiary and appears in the foothills. This brackish-water formation marks the final retreat of the sea from the central part of the continent. The beds beneath representing deposits about two thousand feet in thickness are mainly of marine origin interspersed by wedges of sands and clays extending from the west for varying distances, indicating the time and amount of tilting given to the then shallow sea basin by periodical elevations of a land area situated in what is now British Columbia.

All these beds are exposed at some part of the plains by the trenching action of the rivers and are bored into by the prospectors for gas and oil. The succession is fairly uniform over great areas, but owing to the shape of the bottom of the basin and the fairly even surface of the plains several of these formations appear in succession on the surface.

The successive beds mentioned above have been indicated in diagrammatic form in Fig. 1 in which the contour of the basin is disregarded and the deposits which go to build up the plains are depicted as lying on a flat surface which represents the older beds which formed the sea floor, namely, the limestones that are exposed around the Manitoba lakes and in the Rocky mountains.

THE NUMBERED DIVISIONS OF THE DIAGRAM

(1) Over the western and southern part the marine shales, which are the first deposits of this new arm of the sea, are found to be of Jurassic age. Exposures are to be found in the mountain areas and are called Fernie shales from their great development at that locality.

(2) Sandy beds mixed with soil-making clays form a great deposit along the western edge and indicate a period of retreat of the sea. In these there are **very** many coal seams which form the greatest part of the coal reserves of the foothills and mountains. The deposit is called the Kootenay formation.

(3) Sandy deposits with conglomerates in the mountains, sands and shales, probably marine, extend to the middle part of the plains, while fine sands are found in the eastern part. These sands represent the land deposits of the Dakota horizon. In the foothills and mountains sandy beds at this horizon are grouped under the name Blairmore formation.

(4) A great thickness of dark shales containing marine shells and fish remains are grouped under the name Colorado group. In the east they are subdivided into a calcareous upper group called the Niobrara formation, and a dark non-calcareous shale series beneath called the Benton. In the west the whole series resembles the Benton and the usage is to refer to the beds as the Colorado. The series is about nineteen hundred feet thick in the mountains but diminishes eastward to less than nine hundred in the Manitoba escarpment. This sea deposit shows very little evidence of the extent of the submergence with the exception of occasional sandy beds in the west which are confined to the lower part of the formation.

(5) On the surface of the Colorado deposits there is a layer of sand which is in evidence only in the western part. This indicates a retreat of the sea which was of short duration. In southern Alberta there does not seem to be indication that any of it was deposited above sea level though in Montana there are small coal seams which would indicate estuarine conditions. In Canada these sands are the Milk river sandstone.

(6) In this division the foothills show an undivided sandstone formation. In the vicinity of Lethbridge the formation is divided downward into fresh-water deposits overlying beds of brackish-water formation, and eastward these gradually are replaced by marine beds. The western group was described as the Belly river group which included the Milk river sandstone. This series of deposits are contemporaneous with the invasion of the sea that is marked by the lower Pierre shales of the eastern part of the plains, and indicate that the western margin of the sea was

within the area occupied by the plains. No direct evidence of an eastern border to this sea is given by these deposits.

(7) The principal deposits of this division consist of a marine shale, the Bearpaw or upper Pierre shale, the exposures of which are confined to Alberta and southern Saskatchewan. This marine deposit thins out to the west and in the northern foothills cannot be recognized. Instead there is a great thickness of sandy shore deposits. In the vicinity of Edmonton clays and coal seams replace the sandy deposits and are called the Edmonton formation. The marine beds are about six hundred feet in thickness and the wedge of shallow water formation partially overlying the thinning marine beds is, at Edmonton, about seven hundred feet in thickness. In the southern foothills where the marine shales indicate a wider sea the brackish-water covering beds are much thinner and have been called the St. Mary formation.

East of the central part of the plains the marine beds are slightly thinner and overlies sandy beds of the preceding shallow-water formation, and seem to include in their strata beds that would indicate an eastern zone of elevation following that of the preceding one on the west. In the slopes of Turtle mountain, Manitoba, a few coal seams and sandstones appear to be contemporaneous with the marine deposits of this division and of the Edmonton formation at the west.

(8) All the beds found above the Edmonton are of land formation transported and spread out by fresh water. They are of Tertiary age. In the foothills they are called the Porcupine Hills beds and the Paskapoo formation. In southern Saskatchewan they are partly subdivided in the Cypress hills and around Estevan and are correlated with the Fort Union.

The movements of the crust of the earth during the building of the Rocky mountains and the subsequent plaining of the warped surface bring the various beds to view. A section through southern Alberta, Saskatchewan and Manitoba, drawn to the same scale as Fig. 1, is given in Fig. 2. The sandy members of the section are generally porous and are receptacles for gas, oil and water. Where the beds are dry the retention of gas is due mostly to structure, and if oil is present would be looked for in the lower parts. Generally, however, the beds contain more or less water and most of the deep wells encounter a salt water near sea level that may have remained in the basin since its emergence from the sea. Rolls in the beds would generally then be sealed by water in the lower portions, and gas pockets and even oil could be expected in the sandy beds under arches of the shales.

Slight indications of oil and gas have been found in the upper sandy beds but the greater flows of gas and the only promising showings of oil are found below the great shale beds. Gas has been found in beds represented by layer No. 5 of Fig. 1 at Medicine Hat, and in the sandy beds of the bottom of the Colorado or top of the Dakota represented as layers 4 and 3 of the same diagram. The fields utilized for this gas are Bow Island and Viking. Below the gas in beds probably Lower Cretaceous in age several showings of oil are obtained notably the tar sands at McMurray on the Athabaska and the oil sands at Peace River. Studies of the structure and the general sections are to be found in Memoir No. 116 of the Geological Survey.

FIGURE 1
Vertical Scale 4000'-1 inch

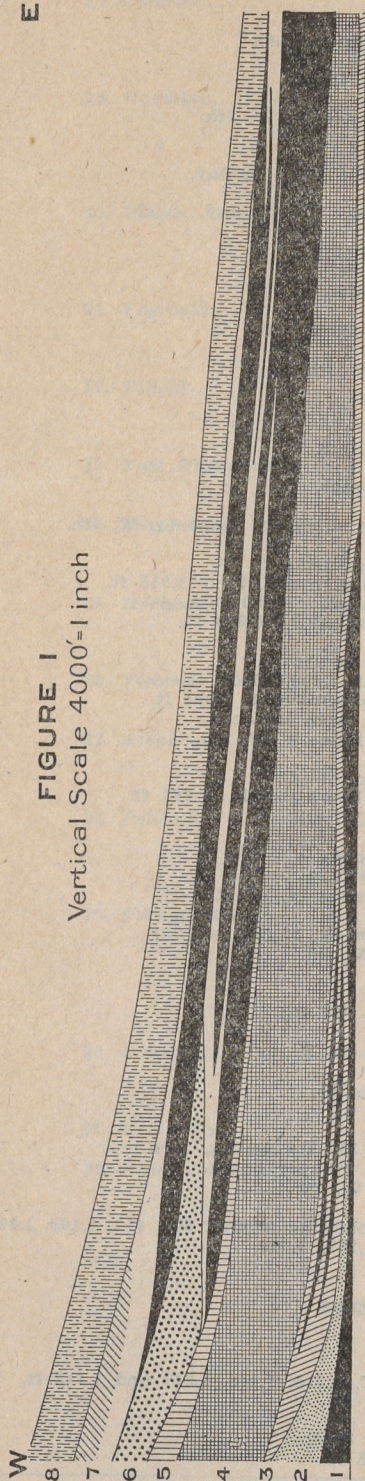
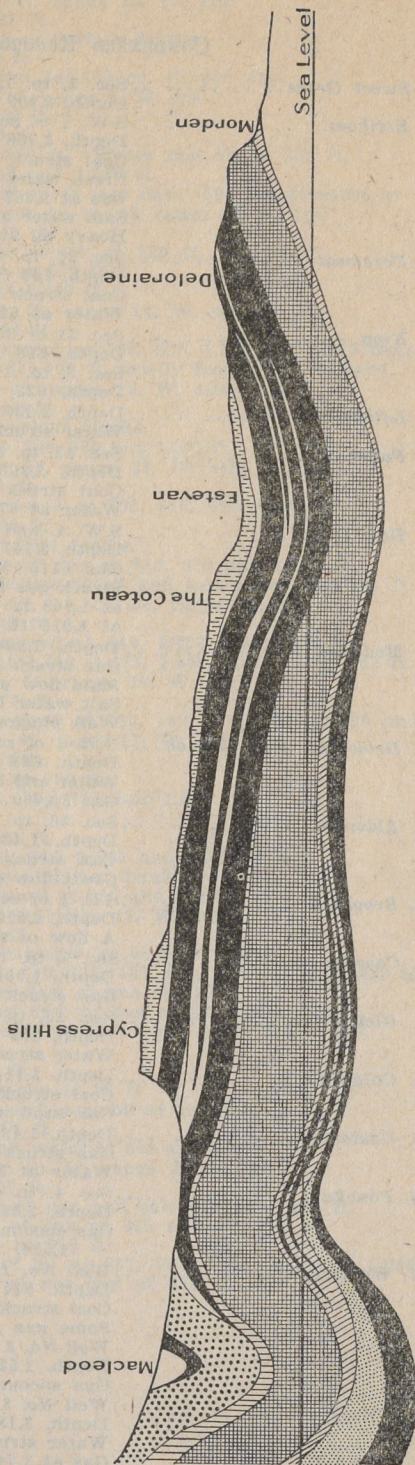


FIGURE 2
East-west section across southern plains
Vertical Scale 4000'-1 inch



CONDENSED RECORDS OF SELECTED WELLS *

1. *Sweet Grass* Sec. 1, tp. 1, range 12, W. 4th.
Depth, 2,900 ft.—dry.
2. *Etzikom* S.W. $\frac{1}{4}$ of sec. 31, tp. 5, range 10, W. 4th.
Depth, 3,705 ft.
Coal struck at 520 ft.
Fresh water at 543 ft. 16,000 gals. per day.
Gas at 1,663 ft. 2,015 ft.
Salt water at 2,250 ft.—7,000 brl. per day.
Heavy oil at 2,985 ft.
3. *Foremost* Sec. 20, tp. 6, range 11, W. 4th.
Depth, 760 ft.
Coal struck at various depths.
Water at 625 ft.
4. *Kipp* Sec. 34 or 35, tp. 9, range 23, W. 4th.
Depth, 658 ft. Dry.
Sec. 9, tp. 11, range 22, W. 4th.
Depth, 622 ft. Dry.
5. *Lethbridge* Depth, 2,220 ft.
Water struck at 1,603 ft.
6. *Faber* Sec. 32, tp. 9, range 16, W. 4th.
Depth, 2,350 ft.
Coal struck at various depths.
Water at 670 ft.
7. *Bow Island* S.W. $\frac{1}{4}$ and N.W. $\frac{1}{4}$ of sec. 4, tp. 11, range 11, W. 4th.
Depth, 2,147 ft.
Gas (110,000 ft.) struck at 1,884 ft.
Struck gas in great quantity from 1,898 to 1,915 ft.
at 1,908 ft. the well measured 4,400,000 ft.
at 1,915 ft. the well measured 7,000,000 ft.
8. *Medicine Hat* Depth, 1,984 ft.
Gas struck at 905 ft. and at 930 ft.
Main flow of gas at 980 ft. 2,500,000 cu. ft.
Salt water heavy flow, encountered at 1,984 ft.
Well plugged to 1,200 ft. from surface.
9. *Drowning Ford Ranch* N.E. $\frac{1}{4}$ of sec. 21, tp. 15, range 5, W. 4th.
Depth, 668 ft.
Water and light flow of gas at 142 ft.
Gas 50,000 cu. ft. per 24 hours struck at 668 ft.
10. *Alderson* Sec. 30, tp. 15, range 10, W. 4th.
Depth, 1,426 ft.
Coal struck at various depths.
Great flow of gas at 1,150 ft.
11. *Brooks* S.E. $\frac{1}{4}$ of sec. 33, tp. 18, range 14, W. 4th.
Depth, 2,595 ft.
A flow of about 20,000 cu. ft. of gas per day.
12. *Cassils* Sec. 5, tp. 19, range 15, W. 4th.
Depth, 1,000 ft.
Gas struck at 825 ft.
13. *Gleichen* Sec. 13, tp. 23, range 22, W. 4th.
Depth, 502 ft.
Water struck at 155 and 464 ft.
14. *Calgary* Depth, 3,414 ft.
Coal struck at various depths.
Gas sand at 2,761 ft.
15. *Castor* Depth, 1,455 ft.
Gas struck at 1,392 ft. (300 lbs per sq. inch.)
Water at 1,433 ft. (20 brl. per hour).
16. *Ponoka* Sec. 4, tp. 43, range 25, W. 4th.
Depth, 2,350 ft.
Gas encountered at the following depths: 853, 912, 1,106, 1,396,
1,524, 1,872, 1,930, 2,257, 2,300.
17. *Wetaskiwin* Well No. 1.
Depth, 944 ft.
Coal struck at various depths.
Some gas at 558 ft.
Well No. 2.
Depth, 1,511 ft.
Gas encountered at 1,187, 1,216, 1,248, 1,347 and 1,443 ft.
Well No. 3.
Depth, 3,180 ft.
Water struck at various depths.
Gas at 1,740 and at 2,035 ft.

*From Memoir 116, Geological Survey of Canada.
Information compiled by D. B. Dowling.

18. *Camrose* Sec. 2, tp. 47, range 20, W. 4th.
 Depth, 1,235 ft.
 Coal struck at various depths.
 Gas at 700 ft.
 Gas obtained 149,200 cu. ft. per day.
19. *Hawkins* Sec. 4, tp. 45, range 8, W. 4th
 Depth, 1,620 ft.
 Gas at 192 ft.
 Water at 270 ft. Water and oil at 300 ft.
 Oil at 1,215 and 1,582 ft.
 Gas 500,000 cu. ft. per day. 500 lbs. pressure at 1,620 ft.
20. *Viking* N.W. $\frac{1}{4}$ of sec. 24, tp. 48, range 13, W. 4th.
 Depth, 2,340 ft.
 Good water struck at 120 ft.
 Salt water at 690 ft.
 Gas flow at 2,340 ft.
21. *Vegreville* Sec. 18, tp. 52, range 14, W. 4th.
 Depth, 2,000 ft.
 Gas encountered at 328, 515, 1,360 and 1,870 feet. Total flow
 about 225,000 ft. mostly from 1,360 ft. sand.
22. *Tofield* Sec. 1, tp. 51, range 19, W. 4th.
 Depth, 1,203 ft.
 Water at various depths.
 Gas at 273, 390, 960 and 1,065 ft.
23. *East Edmonton* Sec. 30, tp. 52, range 23, W. 4th.
 Depth, 940 ft.
 Gas encountered at 295, 610, 683, and 822 ft.
24. *Edmonton* Depth, 1,800 ft.
 Coal at various depths.
 Small flows of gas at 610, 910 and 1,243 ft.
 Small quantities of oil and salt water at 1,243 ft.
25. *Morinville* S.E. $\frac{1}{4}$ of sec. 13, tp. 56, range 25, W. 4th.
 Depth, 3,340 ft.
 Gas encountered at 440, 2,456, and 2,940 ft.
 Some oil at 1,410, 1,475, 1,498, 2,940 and 3,262 ft.
26. *Victoria* Sec. 12, tp. 58, range 17, W. 4th.
 Depth, 1,870 ft.
 Gas encountered at 180, 480, 970, 1,030, 1,090 and 1,500 ft.
27. *Athabaska* Sec. 21, tp. 66, range 22, W. 4th.
 Depth, 1,770 ft.
 Salt water at 780 ft.
 Gas at 245, 334, 780, and 1,650 ft.
28. *Pelican* No. 1.
 Depth, 2,069 ft.
 Gas at 625, 644, 1,560 and 1,879 ft.
 Strong flow at latter depth.
 Some heavy oil at 882 and 903 ft.
29. *Pelican Rapids* Sec. 6, tp. 79, range 17, W. 4th.
 Depth, 837 ft.
 Water encountered at various depths.
 Gas at 253, 310, 355, 450, 625, 750, 773, 820, 830 and 837 ft.
 Tremendous flow of gas at 820 ft.
 Very strong flow of gas at 837 ft.
 Maltha at 355 and 625, heavy oil at 743 to 800.
30. *House River* Well No. 1.
 Depth, 295 ft.
 Water and gas at 82 ft.
 Heavy gas and some oil at 290 ft.
31. *McMurray* Depth, 1,405 ft.
 Salt and salt water at 604 and 779 ft.
32. *Peace River* Probably in tp. 84, range 21, W. 5.
 Depth, 1,107 ft.
 Small flow of gas and salt water at 220 ft.
 Good flow of gas at 415 and 495 ft.
 Small flow at 910 ft.
 Showings of oil at 857, 980, 992, 1,083 and 1,085 ft. About
 5 bbl oil per day at 870 ft.

III

The Development of the Petroleum and Natural Gas Resources of Western Canada.*

For describing the development of the petroleum and natural gas resources of Alberta it will be convenient to divide the province into regions as follows:—

- (1) The Foothills region—the rough and hilly belt fringing the Rocky mountains north and south for the full length of the west boundary of the province.
- (2) The Southern Plains region—the plains south of a parallel through Calgary.
- (3) The Central Plains region—the prairie south of a parallel through Athabaska Landing.
- (4) Peace River region—The valley of Peace river.
- (5) Athabaska region—The valley of Athabaska river.
- (6) The Mackenzie basin—The general region north of Lake Athabaska.

THE FOOTHILLS REGION

PINCHER CREEK DISTRICT

The Pincher Creek district embraces all the southwestern foothills and the outer Rocky Mountain range from the United States boundary to township 6 and may be divided into three fields. The Waterton Lake field, the Oil City field, and the Pincher field. This was the first area in southwestern Canada to be explored solely for petroleum. The original "wild catters" were attracted by the numerous oil springs not only in the district, but also south in Montana and west in British Columbia. The most complete account of the early operations (1903-1912) will be found in the Mines Branch Publication, Petroleum and Natural Gas Resources of Canada, Vol. II, pages 277-280.

The results of exploratory drilling are summarized below:—

Location of district—Southwesterly foothills and mountains. Number of fields, 3.

(1) Waterton Lake field (at base of mountains)—		
Wells drilled.....	3	
Wells encountering oil.....	1	(said to be 18-20 brls. day).
Dry holes.....	2	
Production.....	nil.	
Wells abandoned.....	3	
(2) Oil City field (inside first range)—		
Wells drilled.....	10	
Depths attained.....	200	feet to 1,400 feet.
Dry holes.....	9	(small showing in all wells but 9 practically dry).
Oil wells.....	1	(Lineham well).
Wells abandoned.....	10	(The Lineham well has since 1914 been uncapped and attempt made to clean it out),
Production.....	nil.	
(3) Pincher field (near town of Pincher Creek)—		
Wells drilled.....	2	
Wells drilling.....	2	
Depths.....	1,800	feet.
Dry holes.....	2	
Production.....	nil.	

* By S. E. Slipper, Petroleum Engineer, Mining Lands and Yukon Branch, Ottawa.

Oil Horizons of the Pincher Creek district.—The structure, position, geological age, etc., of the oil deposits in the Pincher Creek district are decidedly obscure. No definite depth of drilling or the character of the "pay" sands can be specified. The oil has probably accumulated in fissures.

Analysis of the Oil from the Lineham well.—The following is an analysis of the oil by Little, of Boston:—

Below 150°C. light oils..	5.1 per cent
150-300°C. illuminating oils	41.0 " "
300-400°C. lubricating oils..	41.1 " "
Paraffin residue and loss..	9.7 " "
	<hr/>
	96.9 " "

Present Exploratory Drilling and Development in the Pincher Creek district.—Wm. Livingstone, of Calgary, is at present engaged in clearing out the old Lineham well.

The Northwest Company (Imperial Oil, Ltd.) have begun drilling operations south of Pincher near Twin Butte post office.

General Conditions affecting drilling in the Pincher Creek district.—The mountainous portion of the district is extremely rough, almost totally lacking in passable trails and is otherwise generally inaccessible. The distance from rail transportation is 30 or 40 miles.

SHEEP RIVER, WILLOW CREEK AND HIGHWOOD RIVER DISTRICTS OF THE FOOTHILLS REGION

The foothills north of Pincher Creek may be divided into three districts: The Sheep River district, the Highwood River district and the Willow Creek district.

The Sheep River District

The Sheep River district comprises the foothills in townships 19, 20 and 21. The Turner Valley field (otherwise known as the Dingman field, Black Diamond field and Calgary Oil fields) is in this area and is the only field in Western Canada producing petroleum commercially. The following is a tabulation of the wells in the Turner Valley field:—

On the Turner Valley Anticline

Wells started..	19
Oil wells..	6
Gas wells..	2
Wells abandoned (dry holes)..	2
Wells abandoned (incomplete)..	5
Wells drilling..	4
Production average per well..	10 brls. per day
Greatest production..	rate of 40 brls. per day.
Least production..	rate of 100 brls. per month.
Depth to producing oil sands..	2,200-3,500 feet.
Maximum depth of drill..	4,320 feet.
Average time to drill a well..	2 years.

Conditions affecting Drilling in the Turner Valley Field.—The rock strata are highly inclined and consist of alternating hard sandstone and soft shale which causes continual trouble with "crooked holes" and caving walls. Drill holes are generally started with either 18 or 15½-inch casing, but conditions are so irregular that the casing records of no two wells are alike. Holes should be started with the expectation of drilling 3,500 feet or more. The average time to drill a well has been two years and the cost is generally in excess of \$50,000.

Gravity—0.7605=54°—Beaume.	
Below 150°.....	58%—gasolene fraction, 0.7280—62° Be.
150°-300.....	28.4% kerosene fraction, 0.7968—45.7° Be.
300°-350°.....	3% light lubricating fraction, 0.8390—37° Be.
.....	9% paraffin residue.
Loss.....	1.6%
	<hr/> 99.0%

This is oil from the southern Alberta well. There are lighter and heavier oils obtained from other wells on the field.

Gasolene from Natural Gas by Absorption Process—

Number of plants..	1	
Number wells supplying gas..	2	
Daily production wet gas..	2,500,000	cubic feet.
Daily output of gasoline by absorption plant..	700	gal. (app.)

Sheep River district east of the Turner Valley field—

Number of wells started.....	5
" " " abandoned (dry).....	5
Depths attained.....	1,500-3,000

Drilling Conditions East of Turner Valley Field.—The depths to possible oil and gas horizons is so great that it is useless to expect success in the area extending for many miles east of the Turner valley.

Sheep River District west of the Turner Valley Field.—Extensive drilling was done in the hills to the west of Turner valley.

Number of wells started.....	6
" " " abandoned (dry).....	6
Depths attained.....	3,000 feet.

Drilling Conditions.—Aside from other unfavourable features, the foothills to the west are so complicated in structure due to extensive over-thrusting that the choosing of favourable acreage is, in most localities, impossible.

HIGHWOOD RIVER AND WILLOW CREEK DISTRICTS

There are several favourable "structures" in the Highwood River and Willow Creek districts, but exploratory wells have been located in very unlikely places.

Wells started.....	7
" abandoned (dry).....	3
" " (incomplete).....	3
" drilling.....	1
Depths attained.....	3,000 feet.

Drilling Conditions.—Practically the same as in the Turner valley. Depths to oil sands somewhat shallower owing to lower dips.

FOOTHILLS IMMEDIATELY SOUTHWEST OF CARDSTON

Wells started.....	4
“ abandoned.....	4
Depths attained.....	2,900 feet and over.

Remarks.—Most of the drilling was done through overthrusting.

Foothills from Township 21 North to Bow River

Wells started..	8
" abandoned..	8

One well obtained a showing of oil and another produced a small flow of gas. The general conditions are much the same as in the southern foothills except that the "structures" are uniformly unfavourable.

Foothills from Bow River North to Township 33

Wells started..	4
" abandoned..	4
Depths attained..	4,500 feet.

Two wells obtained small flows of gas. The general conditions north of Bow river are similar to the southern areas except that dips average lower and there is thicker cover over the sands.

Foothills From Township 32 North

The foothills of the north have not been drilled for oil or gas.

The Southern Plains Region

This large region has been rather ignored by drillers exploring for oil. In the southern plains region are located the two important producing natural gas fields of Alberta.

Wells started (for oil)..	5
" abandoned (incomplete)..	1
" " (gassers)..	2
" " (flooded)..	1
" drilling..	1
Depths attained..	3,700 feet.

Oil indications.—The flooded wells obtained "showings" of oil with the water. Thick beds of "Maltha" were encountered below 2,500 feet.

Drilling Conditions.—The strata lie horizontal; in the upper beds hard ironstone occurs interleaved with clays that do not "mix" well. Heavy flows of fresh water are encountered in wells at depths of 400 to 600 feet. Below 600 feet, beds of soft caving shale make up the section. There are gas and water sands below 2,000 feet. From 2,800 feet to over 3,500 feet rapid progress in drilling is general. Deep holes are started with 18-inch or 20-inch O. D. pipe. Standard cable tool drilling outfits are used exclusively. One rotary drilling outfit was used on a deep well with success but rotary tools are not recommended.

CENTRAL PLAINS REGION

Drilling for oil in central Alberta was first undertaken by the Dominion Government while testing for the southern continuation of the McMurray tar sands. The well was drilled at Victoria (Pakan) in 1899.

In the Central Plains a large number of wells for gas have been drilled. The following data on wells drilled for petroleum is submitted:—

Wells started..	8
" abandoned dry..	4
" " incomplete..	2
" drilling..	2

While drilling the gas wells at Viking one or two of the wells were drilled below the gas horizon to test for oil. In these tests a little asphaltic oil was found together with a flow of saline water at a depth of 2,460 feet.

The following is an analysis of the oil (Milton-Hersey, Montreal):—

Gravity..	19.7 Be.
Below 150°..	5% gasolene.
150°-300°..	22% kerosene.
300°-350°..	15% lubricating.
Above 350°..	58% asphaltic residue.

Small showings of oil were found in the well drilled near Irma on the G.T.P. and in a well drilled near Morinville.

Recently drilling has been started on some crumpled beds in a westerly pitching syncline south of Czar.

The exploration and development of the petroleum possibilities of the Central Plains may be said to have just commenced and no statements can yet be made on the results of development.

Drilling conditions will probably be similar to those of Southern Alberta, running sand, salt water flows, gas flows and caving beds will retard drilling operations to some extent. There are several types of structure, and drilling depths to oil horizons will vary greatly in different parts of the region.

THE PEACE RIVER REGION

Since 1914 drilling has been in progress along Peace river from the town of Peace River downstream for a distance of 15 or 16 miles. Previous to this a 700 foot drill hole was put down at Vermilion chutes. The well was drilled entirely in Paleozoic limestones and was a dry hole. The other wells are drilling in the Lower Cretaceous and have obtained a heavy asphaltic petroleum (12014 Be.) near the base of the Cretaceous. None of these wells have penetrated the limestones.

In some of the wells, the oil occurs in two "pays"; above the upper "pay" there is a heavy flow of gas and the oil saturates about 50 feet of underlying sandstone. Beneath the oil is a strong flow of saline water. The gas, oil and water are apparently all in the same sandstone. The second "pay" is in a lower sandstone separated from the upper sandstone by a shale stratum of varying thickness.

Below the second "pay" but in the same sandstone is a large flow of "sulphur" water. Succeeding the "sulphur" water are beds of thick Maltha and a strong gas horizon.

A comparison of the drilling records of the Peace river wells indicates that there is considerable irregularity in the arrangement of the oil, gas and water accumulations in the sands, though structurally the beds are inclined very little from the horizontal.

Drilling Conditions.—The strata above the oil horizon in the Peace River district, consisting of horizontal sandstone beds and tough sandy shales, offer ideal conditions for cable tool drilling. Practically no caving takes place and little or no water to cause a "wet hole." One company has drilled a 13-inch hole 1,000 feet deep with only a few feet of casing at the top and the walls are standing without a sign of caving. However, when the oil sands are penetrated troubles begin at once with water and gas. In no well that has reached the oil sand, has the flow of water been controlled sufficiently to enable the operator to test the capacity of the well.

Number of wells started	9
" " " (drilled to oil sand)	5
" " " which obtained oil	3 (in amounts over 1 bbl. per day).
" " " abandoned (water)	3
" " " " (incomplete)	3
" " " drilling and "mudding off"	2
" " " obtaining gas	5

Production.—There has been no production owing to "water conditions." Wells have been estimated to show from one to 30 barrels per day.

Future Development.—Every effort should be made by the operators in the Peace River region to eliminate the danger of flooding from the water sands. In order to properly study the water conditions in the field co-operation among the operators is absolutely essential. The possibility of obtaining a production from deeper horizons is worthy of deeper exploratory drilling.

High Prairie Field.—A well has been started in the Peace River district south of the development along the river, near the hamlet of High Prairie.

Drilling Conditions.—The High Prairie region is structurally different from the Peace River field. The drilling has not progressed far enough to give information on drilling conditions.

Wells started	1
“ abandoned	0

Athabaska River Region.—The exploratory drilling along the Athabaska river has been controlled by the river having cut a deep valley through beds at the Cretaceous-Paleozoic contact and exposing the basal sandstones of the Cretaceous heavily impregnated with maltha or apparently inspissated petroleum.

Shallow wells have been drilled into the petrolific beds along the river bank or a short distance inland from the banks, on the theory that the petroleum would be fluid where not exposed on the surface.

Deep wells have been drilled into the petrolific beds southward some miles, where there is several hundred feet of cover, on the theory that the oil would be fluid “down the dip.”

Deep wells up to 3,000 feet have been drilled into underlying Paleozoic formations to test the possibilities of the older series containing oil sands.

Some of the shallow wells seem to have obtained a small production of fluid oil (seemingly accumulated in basins) but otherwise all the exploratory drilling for oil along the Athabaska has been unsuccessful. The deep wells obtained the same “tar” as is exposed at the surface. Large flows of gas were also obtained from some of the deep wells.

Exploratory drilling for petroleum was begun in 1894 by the Dominion Government. At the present time drilling in this region is at a standstill.

Shallow wells drilled	12 (?)
“ “ abandoned	12 (?)
Deep wells drilled (including wells drilled for gas)	12
“ “ abandoned (for oil) (including gas wells capped)	12
Gas wells capped	5

**Mackenzie River Basin.*—Two drilling outfits have been shipped into Mackenzie country but so far no exploratory drilling has been done.

NATURAL GAS SOUTHERN PRAIRIE REGION

The Medicine Hat Gas Field. The Medicine Hat field has a proven area of some 40 or 50 square miles.

Natural gas is supplied for various purposes to the city of Medicine Hat, to Redcliff and to many industrial plants.

There are two gas horizons; the “shallow” gas at 700-800 feet and the “deep” gas at 1,000 to 1,200 feet. The shallow gas was the first developed.

The shallow gas had an initial pressure of about 270 pounds and the wells yielded from 50,000 to 100,000 cubic feet per 24 hours. The wells to this horizon were all “wet” and gave considerable trouble; they are not used at the present time.

The gas in the deep sand had an initial pressure of 560 pounds and volumes up to 4,500,000 cubic feet per day open flow were reported in the early history of the field. The first deep wells were drilled in 1900 and the latest drilling was in 1917. The greatest drilling activity was in 1913. At present the closed pressure of the wells averages about 470 pounds and the open flow appears to be about 2,000,000 cubic feet per day on an average.

* Since compiling this report advice has been received that the Imperial Oil Company have made considerable progress in drilling at a location on the Mackenzie river north of Norman. It is reported that the well has penetrated oil sands at one hundred and eighty, four hundred, and eight hundred feet. The two upper horizons are reported to show a production of five to ten barrels per day while at the time of writing unconfirmed press bulletins stated that a gusher was penetrated at eight hundred feet.

Shallow wells drilled.....	7
" " abandoned.....	7
Deep wells drilled.....	32
" " abandoned.....	0
" " gassers.....	32

In 1919 the consumption of gas by Medicine Hat city and industries obtaining gas from the city amounted to 2,559,658,000 cubic feet. Privately owned wells and the town of Redcliff would probably account for 2,000,000,000 cubic feet additional, so that it is estimated the annual production of the Medicine Hat field is in excess of 4,000,000,000 cubic feet.

Future Development.—There is considerable acreage within the proven field yet to be drilled.

Theoretical calculations, which however, are not based on sufficiently complete data, would indicate that the field has about half of its productive life remaining.

The Bow Island Gas Field.—The Bow Island Gas Field covers an area of about 20 square miles in townships 10 and 11, ranges 11 and 12, west of the 4th meridian. This field borders the South Saskatchewan river, north of Burdette station on the Medicine Hat-Lethbridge line.

The field was opened in 1908 by the C.P.R. but subsequent extensive development was executed by the Canadian Natural Gas, Light, Heat and Power Company for the purpose of supplying natural gas to Calgary and other communities.

The original rock pressures averaged 750 pounds to the square inch and wells of over 20,000,000 feet open flow capacity were brought in. At present (September, 1920) the average rock pressure is less than 250 pounds. Several of the wells are being flooded with encroaching water and practically all recent drilling has developed "dry holes."

The gas sand occurs at about 400 feet above sea level and drilling depths varying from 1,900 to 2,500 feet.

Number of wells drilled.....	25
" " " " in dry.....	4
Number of gas wells abandoned.....	4

Future Development.—Recent drilling results indicate that the field has practically reached the limit of usefulness in supplying gas to the Calgary gas line. There is probably less than one-quarter of the original volume of gas remaining in the field. The decline of the Bow Island gas field has led to drilling activity in other prospective gas fields in southern Alberta, but so far with very disappointing results.

Chin Coulee Field.—Some drilling for gas has been done in the vicinity of Barnwell station on the Medicine Hat-Lethbridge line of the Canadian Pacific Railway. Depths of 2,600 feet have been drilled. The total open flow of the field is 4,000,000 feet all coming from one well, and the recorded closed pressure is 630 pounds. After two years service the gauge pressure of gas in this well is now 460 pounds.

Number of wells drilled.....	3
" " " abandoned.....	2
" " producing wells.....	1

Monarch Field.—The Monarch field is located midway between Macleod and Lethbridge on the north bank of the Old Man river. No drilling operations have been completed in this field.

Number of wells drilled.....	0
" " drilling.....	2
" " producing.....	0

Forty Mile Coulee Field.—A well has been drilled for gas 18 miles south of the town of Bow Island in Forty Mile coulee, to a depth of 2,000 feet. No gas being obtained the well has been abandoned.

Number of wells drilled	1
" " " abandoned	1
" " " producing	0

Suffield, Alderson, Brooks, Bassano Fields.—Small volumes of gas are obtained from wells drilled several years ago in these towns on the main line of the Canadian Pacific railway. The greater quantity of ore gas is used by the Canadian Pacific railway for heating and lighting station houses, pumping water, etc.

NATURAL GAS CENTRAL PLAINS REGION

Irma Gas Field.—This field is located on Battle river, midway between Irma and Wainwright on the main line of the Grand Trunk. The depth to the gas sand is 1,900 feet from the river bed. One well has penetrated to the gas sand and has an open flow capacity of 5,000,000 cubic feet for 24 hours, and a closed pressure of 650 pounds.

Number of wells drilled	2
" " " abandoned incomplete	1
" " " obtaining gas	1

Drilling conditions appear to be ideal though some rather troublesome caving formations were encountered in the upper beds drilled.

This location seems to have a promising future as a productive gas area.

Viking Gas Field.—An extensive gas field has been developed over a large area lying between Viking on the Grand Trunk Pacific and Birch lake. The gas occurs in two sands at a depth between 2,100 and 2,300 feet in the wells drilled, pressures up to 800 pounds are reported, and an average open flow capacity of 4,000,000 cubic feet per well is recorded.

Number of wells drilled	9
" " " drilling	1
" " " abandoned	0
" " " obtaining gas	9

At present all the wells are closed in. The field was developed for the purpose of supplying Edmonton with gas.

Drilling Conditions. Drilling conditions are described under the section on the oil possibilities of this region. The Viking field would appear to have a very important future.

Wetaskiwin Gas Field.—The city of Wetaskiwin has obtained a supply of gas for several years within the city limits from a horizon about 1,300 feet deep. The quantity of gas amounts to only a few hundred thousand feet per day, and a rock pressure of about 100 pounds. The gas is used to operate gas engines which furnish power to the electric plant and water supply plant.

Number of wells drilled	3
" " " abandoned	1
" " " producing gas	2

Ponoka Field.—Gas has recently been obtained from a well drilled by the provincial government on the asylum grounds at Ponoka. The well is 2,500 feet deep.

Number of wells drilled	2
" " " abandoned incomplete	1
" " " producing gas	1

Tofield, Vegreville, Edmonton, Morinville, Athabaska.—Unsuccessful or uncompleted drilling prospects were undertaken at these various localities in previous years, with indifferent success. Details of the operations may be obtained from Reports of the Geological Survey.

Conditions affecting drilling are similar to those of the Viking and Irma fields.

NATURAL GAS IN THE ATHABASKA REGION

An extensive gas area has been developed on the Athabaska river near Pelican rapids. This gas field is at present too far from consumers to be utilized, and the wells are capped. Further information will be obtained under the section treating with the Petroleum operations in the Athabaska region.

IV

*Synopsis of the Petroleum and Natural Gas Regulations Governing the Disposal of Such Rights on Dominion Lands.

Petroleum and natural gas rights, the property of the Crown, on Dominion lands, may be acquired under lease. The regulations under which such rights are leased are established by Order in Council. Copies of the regulations may be obtained from any agent of Dominion lands, or from the Mining Lands and Yukon Branch, Department of the Interior, Ottawa.

Outside of the Northwest Territories, the maximum area that may be acquired by one person by location is 1,920 acres. If the land is in surveyed territory, the application may be filed without staking. If in unsurveyed territory, it must be staked out in the manner prescribed in the regulations and application filed. All applications should be filed by the applicant in person. A fee of five dollars should be paid when the application is filed, together with the full amount of the rental for the first year, at the rate of fifty cents per acre. The shape of the location should be such that the length would not exceed three times the breadth. The rental for the second and each subsequent year is at the rate of one dollar per acre.

Any individual or corporation may acquire by assignment any number of leases. Assignments are registered in the Department, but they may be filed with the mining recorder of the district to be forwarded to the department. Any company acquiring a lease shall be a company registered or licensed in Canada, and should have its principal place of business within His Majesty's dominions.

Provision is made in the regulations for the granting of extensions of time to pay the rental for the second and third years of the term of the lease, provided application is made for such extension of time within a specified period.

A lease is subject to cancellation in the discretion of the Minister if the lessee fails to instal machinery and equipment suitable for carrying on prospecting operations within one year from the date of the lease.

The lessee should commence boring operations on his leasehold within fifteen months of the date of the lease, and such operations should be continued with reasonable diligence, to the satisfaction of the minister, and if he fails to do so, the lease shall be subject to cancellation in the discretion of the minister upon three months' notice being given to the lessee.

The minister may permit a lessee, who has acquired by assignment more than one lease, to consolidate his operations and expenditure, and to instal machinery and equipment on one or more of the locations. The maximum area of the locations which may be included in one group shall not exceed twenty square miles, and the various locations comprised in the group shall not be separated one from the other by a greater distance than two miles.

If expenditure incurred in boring operations on a location or on a number of locations grouped under the provisions of the regulations has been accepted in satis-

* Furnished by the Controller of Mining Lands and Yukon Branch. (Prepared December 10, 1920.)

SYNOPSIS OF THE REGULATIONS IN FORCE IN THE
NORTHWEST TERRITORIES ON JUNE 15TH 1921.

1. Claims in the Mackenzie District must be staked out on the ground (the land being unsurveyed) in accordance with instructions contained in the Regulations.

2. Applications for a prospecting permit on claims so staked must be made in person to the agent or to a sub-agent for transmission to the agent. The Applicant must present his Entry Certificate upon recording claims.

3. The maximum area of a permit is 2,560 acres, and the minimum area is 80 acres. A permit is good for a term of 4 years only. Locations can be grouped subject to a maximum area of 20 square miles.

4. The rental of a permit is 50 cents per acre for the first year, and \$1.00 per acre for each subsequent year. The second or following year's rental is not required provided an adequate drilling outfit has been installed on the location or one location of a group.

5. A recording fee of \$5.00 together with the amount of the first year's rental, must accompany each application for permit.

6. Prospecting machinery and equipment are required to be placed on the ground within two years from date of permit, and boring operations to be prosecuted during the third year.

7. If oil in commercial quantities is struck a twenty-one year lease may be obtained for one-quarter of the area of the permit, subject to a yearly rental of \$1.00 per acre, and certain Royalties. The holder of the original permit shall have the first option of acquiring the remaining three quarters should it be decided to dispose of same.

8. The permittee who has acquired one or more permits may consolidate his operations and expenditure, and the amount expended on drilling operations on one or more locations in the group may be applied on account of the rental of the whole of the locations in the consolidation.

9. Copies of the Regulations should be secured and their contents carefully noted by intending stakers.

faction of the rental for the second and third years of the terms of the leases, the minister may, in consideration of further expenditure, grant the lessee an extension of time to pay the rental for the fourth and fifth years.

If the surface rights comprised in a location have been disposed of, and the lessee cannot make an arrangement with the owner of such surface rights to enter upon the land, provision is made whereby any dispute in this connection may be settled by arbitration.

If natural gas is discovered, the lessee shall take all reasonable precautions to prevent the waste of such gas. Should salt water be encountered, the lessee shall immediately and effectively close the well to prevent such water gaining access to the oil-bearing formation. The lease shall be subject to cancellation for failure to comply with these requirements.

Before commencing boring operations, the lessee is required to furnish full particulars regarding the location of the well and the kind of machinery to be employed. If the lessee intends to abandon the well, he is required, before commencing the removal of the casing or machinery, to obtain written permission from the minister, or such officer as the minister may designate for that purpose.

The regulations apply to lands in the Railway Belt and the Peace River Block in British Columbia. They do not apply to Dominion parks, Hudson Bay lands, Indian reserves or railway lands.

Provision is made that in forest reserves, lands may be located under these regulations, but with each location the applicant is required to provide for a Crown reserve of equal area. The maximum area which an applicant may acquire in forest reserves is 1,920 acres.

In the Northwest Territories, the maximum area which may be located is 640 acres, one-half of which is to be a Crown reserve.

For a period of five years after oil in commercial quantity has been discovered, the royalty to be collected by the Crown shall not exceed five per cent of the output of the well or the sales of the products of the location as may be decided by the minister, nor shall such royalty be less than two and one-half per cent of such sales. For a further period of five years the royalty to be collected shall not exceed ten per cent of the sales of the products of the location, nor shall it be less than five per cent. Thereafter, the royalty shall be ten per cent of the sales of the products of the location.

V

*Synopsis of Provincial Legislation and Regulations Governing the sale of Shares, Stocks, Bonds, Etc.

THE SALE OF SHARES ACT

The Sale of Shares Act, Chapter 8, Statutes of Alberta 1916, renders it unlawful for any person, company, or any agent acting on his, its or their behalf, to sell or offer to sell or attempt to sell in the province of Alberta, any shares, stocks, bonds or other securities of any company, corporation, syndicate or association of persons without first obtaining from the Board of Public Utility Commissioners a certificate permitting the sale of such shares, stock or other securities.

Any agent soliciting subscription for stocks, shares or other securities in a company is also required to obtain from the Board a license which is renewable each year. This license must be produced by the agent in every case where he solicits subscriptions for or offers to sell shares of stock in any company, etc. The license is not a general license to sell stock or shares but only a license to sell the stock or shares in some particular company which has already obtained a certificate from the Board.

* Board of Public Utility Commissioners for the Province of Alberta.

In order to obtain a certificate permitting it to sell shares within the province, any company or corporation or syndicate or association of persons desiring to sell its shares within the province, is required to file with the Board a statement showing in detail the plan upon which the company proposes to transact business, a copy of its charter or certificate of incorporation, articles of incorporation, an itemized account of its financial condition and other material as set out in the Act or as may be required by the Board.

Before issuing the certificate, the Board requires to be satisfied that the company's plan of business is fair, just and equitable, that its financial condition is sound and that the proposition gives a reasonable promise of success.

The Act does not cover the sale of Government or municipal stocks, debentures, etc., or securities listed upon any stock exchange that has been approved of by the Board for such purpose. Isolated sales of one's own stock or shares also do not come within the Act, but the publication or advertisement in any newspaper, magazine or other periodical or the issue or distribution of any advertisement or circular containing an offer to sell or intimation of the fact of the issue of any such shares or other securities, or solicitation by agents or employees, is to be deemed evidence of an attempt to sell in violation of the provisions of the Act.

Heavy penalties are provided in case of the violation of the provisions of the Act. Copies of the Act with the amendments together with a synopsis thereof can be obtained on application to the Secretary of the Board.

APPLICATION FORM

Following is a copy of the application form supplied by the Board to mining and oil companies or syndicates to be filled up and certified by them:—

BOARD OF PUBLIC UTILITY COMMISSIONERS FOR THE PROVINCE OF ALBERTA.

APPLICATION FORM—(FOR MINING AND OIL COMPANIES OR SYNDICATES).

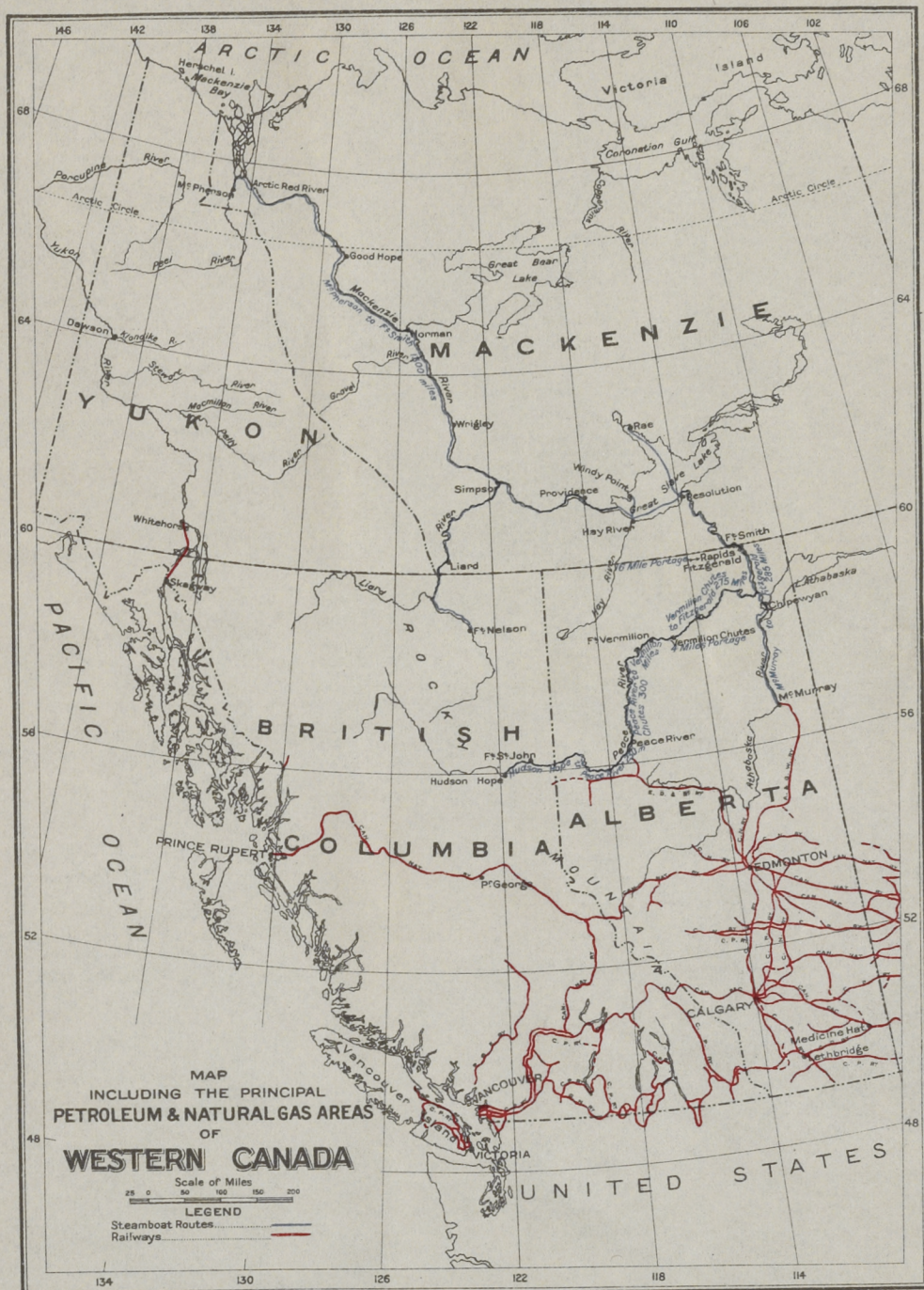
To be filled up and sworn to by the duly authorized officer of the applicant company.

1. Registered name of company
2. Head office (street and town)
3. Class of mineral
4. Geographical location of property (describe fully)
5. Give any additional description of claims
6. Class of title (leases, or Crown grants, etc.)
7. Total annual mineral rentals or assessments in respect of claims \$
8. Capital (nominal) \$ in shares of \$ each
9. Capital (issued) \$ in shares of \$ each
10. Actual cash received for shares already issued \$
11. Present application is for power to sell shares at a price of \$ per share.
12. Is any consideration involved other than cash?
13. If so, what? (Give full details of property and services)
14. What commission is proposed to be paid? %;
In cash \$ in shares
15. Are sales to be made by:—(1) Advertisement? (2) Personal canvass? (3) or both?
16. For what purpose is fresh capital required?
17. Are any contracts pending? (If so attach copies)
18. Has the property been valued by an engineer who has not, nor has had, any interest in the syndicate or company?
19. If so, by whom? (attach copy of his report.)
20. State names of directors:—

Name	Shares taken	Consideration for which shares issued
.....
.....
.....
.....

The Board will, in addition to the form enclosed, require upon the application, the following:—

- (1) A copy of the company's prospectus.
- (2) A copy of the company's by-laws.
- (3) A copy of the contract for shares to be entered into between the company and the proposed subscribers. This form must comply with the requirements of Section 11 of the Sale of Shares Act as amended by the 1917 Statutes.
- (4) An itemized account of the company's financial condition, showing the company's property, assets, and liabilities, the total amount of cash received from the time of the organization of the company, the expenditure and generally a full financial statement of the company's affairs.
- (5) The filing fee, which depends upon the amount of the issue sought to be authorized. A tariff of the fees chargeable is herewith enclosed.
- (6) The Board will also require full information as to the number of shares sold by the company.
- (7) All documents must be verified under oath by a duly authorized officer of the company.



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